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BY

HENRY POWER

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Saturday, August 3.—Afternoon Sitting.

M. DONDERS IN THE CHAIR.

ON TRANSPLANTATION OF THE CORNEA.

By HENRY POWER, F.R.C.S., M.B. Lond., *Senior Ophthalmic Surgeon at St. Bartholomew's Hospital.*

A large number of cases present themselves at every ophthalmic hospital in which, whilst the cornea is almost as opaque as the sclera, the retina retains its sensitiveness sufficiently to permit the patient to discriminate light from darkness, and even the passage of the hand or other large object between the eye and a window. In some of these cases the whole globe is enlarged and filled with a watery fluid; in others the cornea is staphylomatous and immensely thickened, and but little hope can be entertained that any kind of operation will effect a restoration of sight. There are other cases, however, in which the eye preserves its natural size, form, and tension, and, as shown by pathological investigation, the humours their natural consistence and transparency; and it would appear that the only thing required to restore a useful amount of vision is to make a window, through which light may gain entrance to the interior of the globe. Accordingly we find that, with this object in view, an immense variety of methods have been suggested, in the hope that the corneal tissue might be restored to its original transparency. Stimulants of all kinds, both solid and liquid, scarifications, abrasion of the surface, removal of thin lamellæ, have all been tried, and no doubt, in many instances, where the pathological alterations of the corneal tissue have not been too profound, with considerable success. Where, however, the opacity is complete, and the cornea has assumed the appearance and almost the structure of a tendon, the patient is usually at once told that no improvement can be looked for from surgical interference, and that he must bear his affliction with resignation.

It is somewhat surprising that the suggestion for the performance of a plastic operation for the relief of the more favourable class of cases to which I have above alluded should have been of comparatively recent date, if Himly be correct in stating that he was the first to propose in his

lectures,* delivered in 1813, that the cornea of an animal might be transplanted into the eye of another without more than a partial loss of transparency.

In our English works the most casual references only are to be found in regard to such a proceeding. Mackenzie† dismisses the whole subject in a line or two, declaring that all such attempts have failed; whilst Middlemore, Guthrie, Tyrrell, and Lawrence make, I think, no allusion to it at all.

I was much surprised, however, in finding, on following up a reference in Desmarres's treatise,‡ some time after I had commenced my own experiments, that a considerable literature existed upon the subject in the German periodicals, ranging from 1823 to 1844, after which it seems that but little, if any, attention has been paid to the subject.

The first case which led me to think that transplantation of the cornea was possible was that of a patient suffering from glaucomatous symptoms in an eye that had long been blind. With a view of relieving the pain and tension I punched out a large portion of the cornea, and immediately re-applied the part excised. In the course of three or four days complete union had taken place; the piece excised had, however, become very hazy, though not absolutely opaque. The pain continuing unabated, the eye was removed at the end of a week. In effecting this the transplanted portion separated through the greater part of its extent, but it was not the less evident that it had been thoroughly united.

I next proceeded to operate on three dogs, but these operations all failed owing to the animals stroking the injured part with their fore-paws. The instrument used was a sharpened brass Mohr's corkborer, and, owing to the absence of proper fixing apparatus, considerable damage was done to the cornea and subjacent tissues, and I was not surprised at my want of success. On mentioning the subject to my friend Dr. Klein, he very kindly offered to place the advantages and conveniences of the Brown Institute at my disposal, and to give me his valuable aid in performing the experiments. These had for their object, first, to determine whether a cornea after excision would, on being replaced in the same animal, become attached and preserve its transparency; secondly, whether an excised cornea could be removed from one animal to another of the same species; and thirdly, whether the cornea could be similarly transplanted from one animal to another of a different species.

* "Krankheiten und Missbild. des menschl. Auges," Heiberg, Berlin, 1843, vol. ii. p. 60.

† "Treatise on Diseases of the Eye," p. 882. ‡ "Maladies des Yeux," t. ii. p. 339.

I requested Mr. Weiss to make for me a series of extremely sharp steel punches, of which one three-eighths of an inch in diameter was found in practice the most convenient. The animals—rabbits and cats—were rendered completely insensible with chloroform, and were then fixed in a Czermak's rabbit-holder. The lids were separated with a speculum, and the punch being carefully applied, was firmly pressed and rotated. The punch usually cut through one-half or two-thirds of the circle, and the complete excision was effected by means of scissors, taking care to touch the portion to be removed as little as possible. The lens was then carefully extracted, and the cornea was simply replaced, or another animal was similarly operated on, and the corneæ were then exchanged. No sutures were employed, as it was found to be impossible to pass even the sharpest needle without doing much injury to the membrane, whilst I thought the sutures were sure to set up inflammation. Moreover, it was found that neither the hole nor the piece of cornea excised enlarged or contracted in any way, the two fitting exactly, and the excised circle could, therefore, be neatly inserted. In the case of rabbits the membrana nictitans was drawn over the eye, and attached by a suture to the outer canthus of the lids. Where this was neglected the inner half of the cornea was always found, owing to the friction of this membrane, to be very opaque and the union imperfect. The lids were always sewn together. No attempt was made to examine the eyes until after the lapse of a week. It was then usually found that they were hermetically sealed by blood and inspissated pus and lachrymal secretion. Upon dividing the sutures and separating the lids there was a considerable quantity of whitish muco-purulent secretion. Upon removing this, the cornea, when the experiment was successful, was observed to be adherent, and generally of a pearly tint. On several occasions they were sewn up again, but in no instance did the animals live long enough to allow the cornea to regain its transparency perfectly, death occurring apparently from pyæmia; the opacity of the cornea, however, did not exceed that which is often seen in cases of severe keratitis, and which eventually clears up sufficiently to permit large objects to be seen.

I am again indebted to Dr. Klein for having made some beautiful sections, which I here present to the society. It will be seen that the union is perfect, the line of junction being scarcely distinguishable in the proper corneal tissue, and not at all in the epithelium; that the excised and transplanted circle of cornea is greatly increased in thickness, presenting with low powers, a uniformly granular aspect, the granules being resolvable with higher powers, into cells, which are partly corneal corpuscles, and partly pus or young cells. Vessels may be seen passing from

the original into the transplanted cornea. In the latter the laminated character of the tissue has almost entirely vanished, by no means, however, presenting such a character as to lead any one familiar with ophthalmic diseases to consider the recovery of transparency a hopeless affair.

In a note just received from Dr. Klein he kindly gives me the result of his examination of the specimens, and states that the following points are noticeable:—

1. That the epithelium which covers the excised portion of cornea passes without any noticeable interruption from the excised to the un-excised portion of the cornea. The thickness of the epithelial layer, however, diminishes towards the centre of the excised portion.

2. Owing to the presence of projecting vascular arches or loops, running from the deeper parts of the corneal tissue towards the epithelium, both in the outer portion of the excised cornea and in the inner circle of the non-excised cornea, the line of junction of the epithelium with the corneal tissue is not a plane surface, but presents more or less regularly arranged loops, conferring on the surface of the corneal tissue the appearance of being beset with vascular papillæ. To this last circumstance it may be due that the deeper portion of the epithelium grows in the form of cones composed of young epithelial cells.

3. In reference to the corneal tissue itself the most superficial layers are quite continuous in the two parts, both as regards the connective tissue fasciculi and the intermediate cell-rows and bloodvessels. The layers immediately beneath the epithelium in the externally situated parts of the peripheral non-excised cornea and in the internally situated parts of the central excised cornea are richest in young cells—pus cells.

4. This is also the case in regard to the deeper layers of the cornea at the part where the line of union is most distinctly marked, especially in the excised portion of the cornea. Hence the parts of the excised piece adjoining the line of union are more transparent than the corresponding part of the non-excised portion, and the corneal corpuscles are more normal in appearance here than elsewhere. At the same time there are many parts of both the excised and non-excised parts of the cornea, in which the corneal corpuscles appear natural when not concealed by young cells.

5. The tissue rich in young cells, pus cells and bloodvessels—adjoining the line of union of both the excised and non-excised part of the cornea unites very firmly the tissue lying between the fasciculi of the cornea forming one continuous mass.

Since commencing these experiments I have had only two, and these very indifferent opportunities, of trying transplantation on the human

subject. Such as they are, however, I venture to bring them before the Congress, and believe they will be considered to afford good hope that under favourable conditions this operation might be attended with success.

Both cases were cases of extensive staphylomatous protrusion of the cornea occurring in children, as a result of purulent ophthalmia. In both the cornea was of very remarkable thickness, not less perhaps than an eighth of an inch. The boring process was easily performed under chloroform, and a fresh piece of rabbit's cornea of corresponding size introduced; in both cases union occurred by first intuition without sutures, without any irritation, inflammation, or suppuration whatever. In one case the cornea has become opaque, in the other it remains tolerably clear.

In conclusion, then, I have experimented on three dogs, three cats, four rabbits, and two human beings. The dogs and cats failed, but probably owing to want of proper precaution and experience in performing the operation. In the rabbits union occurred in every instance, though the cornea always became pearly white. Only one of these animals, operated on six weeks ago, has lived; in this animal the cornea is still attached, elevated and pearly white. In the experiments on the human subjects the excised portion of cornea being replaced, in one instance grew and remained semi-transparent for a week; whilst in the other two cases the cornea of the rabbit being inserted became attached but lost their transparency.

NEW MODE OF INTRODUCING SUTURES INTO THE CORNEA.

By G. D. WILLIAMS, of Boston.

I want to show a method of placing sutures in the cornea which I have employed with great success. It may be applied to whatever operation is selected, and in my judgment it offers considerable advantages over several of the modes of operating in preventing procidentia iridis and anterior synechia by favouring the more immediate union of the corneal wound, and thus avoiding some of the principal dangers of cataract operations. The needle which is used is an extremely small one, and has to be held by forceps, roughened, which are better than any needle-holder that has a snap in releasing the needle, because of the importance of having no traction upon the cornea whatever. I seize the point of the flap with an iridectomy forceps, and then, passing the needle through the flap, through the superficial layers of the cornea, and then, having placed the suture in the corneal flap, I introduce the